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(54) Digital postage meter system having a replaceable printing unit with system software upgrade

(57) A postage meter mailing system utilizes a meter vault (24) operated under the control of a microcontroller (44) mounted in a secure housing. The microcontroller (44) of the meter vault (24) has a communication device (43) for receiving and transmitting data messages and non-volatile memory (40, 41) for storing program data and other data. A printer (27) is utilized for printing a postage indicia.

The printer (27) operates under the control of a microcontroller (66) mounted in a secure housing. The microcontroller (66) of the printer (27) has a communication device (63) for receiving and transmitting data messages and non-volatile memory (61, 62) for storing program data and other data. An interface (23) provides a communication path between the meter vault and the printer.

The non-volatile memory (40, 41) of the meter vault has stored therein a program version number for identifying the control program version. The non-volatile memory (61, 62) of the printer has stored therein a software update number for identifying associated meter vault programs which utilize the update software. Upon system start-up, the print head microcontroller (60) requests the meter vault microcontroller (44) to transmit the control program version and number and determines whether the control program requires the update software and if so transmits the update software.

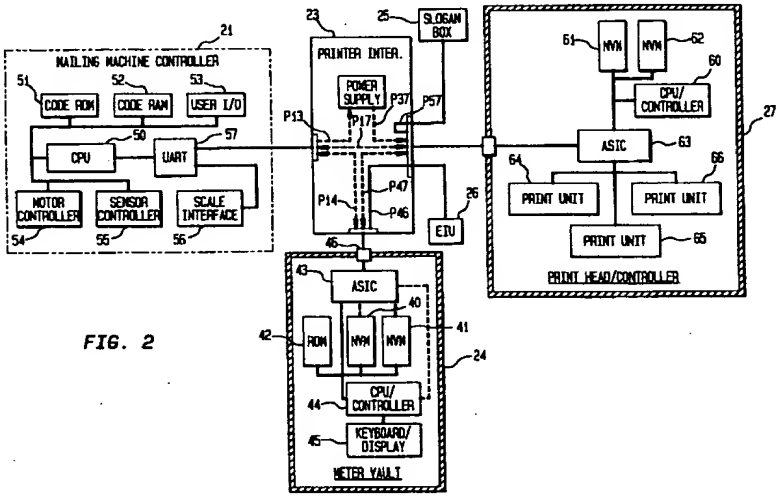

FIG. 2

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Description

The present invention relates to a postage metering system that utilizes a digital printer and, more particularly, to a postage metering system which includes a meter vault and a replaceable digital printing unit which are physically separated.

Generally, a postage metering system includes a meter vault which accounts for the postage printed by a printing unit. The meter vault is comprised of a programmable microcontroller having a program memory for storing the system control program data. In an attempt to employ digital printers, such as ink-jet, in postage metering systems, it has been found that a print module configuration which includes the print heads, drivers and graphic imaging system within a single secure package is desirable. An electronic communication channel is provided between the meter vault and the print module to allow the communication of critical accounting and other data between the meter vault and the print module. This channel may also be used to allow communication between the print module and a mailing machine.

It is conventional practice to provide system software updates from time to time which either correct software defects, increase system efficiencies or add system functionality. Submitting the meter vault to system software updates or modifications has typically been accomplished in one of three ways. Under certain circumstances the meter vault must be taken out of service and returned to the manufacturer where the security housing is removed and special equipment is used to load updated software into the program memories of the system. If sufficient unallocated program memory exists, it may be possible to connect a special service device to a communication port of the meter vault and down load the updated software into the program memory or other usable non-volatile memory. The service device must be specially equipped to preserve the security of the meter vault housing and internal circuit security of the meter vault.

Another way is to trade out the existing meter vault with a new meter vault. All of these processes represent substantial time and cost consequences.

It is an objective of the present invention to provide a convenient means of up-dating the control program data for the meter vault and the mailing machine which all eviates the time and cost consequences of the conventional processes.

A postage meter system in accordance with the present invention includes a base unit, more commonly referred to as a mailing machine, which serves as a platform for the meter unit. The base *includes* a microcontroller system which is responsible for controlling the transportation of envelopes in a sequential manner to a printing location whereat the printing unit can print a postage indicia and any other additional information, such as, an ad slogan, delivery address or bar code on the envelope. In a preferred configuration, it is contemplated that printing will occur during relative motion between the envelope and the printing unit associated with the meter. Therefore, the microcontroller system in the base will be responsible for relatively precise control of the motion of the envelope through the printing location.

The metering is provided by way of two independent units which are a vault and a printer. The vault accounts for and dispenses funds for postal payment. Communication between the mailing machine, vault and printer is facilitated through a printer interface unit. The meter vault communicates with the print head to transfer encrypted messages for postage amount, piece count, and digital tokens. A digital token represents an alphanumeric sequence generated by using any suitable algorithm which uniquely identifies the postage indicia as originating from a particular postage meter system and verifying that that postage meter system is authorized for use by the Postal Authorities. Meter vault communications are routed to the print head through the printer interface. The meter vault securely communicates with the print head using any suitable digital encryption technique.

The printer interface serves as a junction board for the mailing machine, meter vault, slogan box, and print head. This minimizes the number of connection points in the system. The printer interface provides the connections for a serial communication linkage and unregulated DC power from the mailing machine to the meter vault, transfers print command and status signals between the mailing machine and print head, interfaces the slogan box to the print head, supports a unique serial link between the meter vault and print head, and regulates logic and print nozzle power from the mailing machine to the print head.

The slogan box stores graphics images representing the fixed part of the standard indicia (e.g., the eagle printed on US mail), low-value indicia, permit mail indicia, town circle (where appropriate), inscriptions, and customer slogans. It also stores the fonts for printing the variable data on the mail piece. All of the graphics data is either encrypted or signed, that is, subject to other types of encoding algorithms in the slogan box non-volatile memory. The encryption or signing is done at the manufactures' facility. Only the print head contains the necessary decryption key to properly interpret the data.

The communication by the meter vault includes encrypted information. Only the meter vault and the print head know the proper keys to utilize the information. The keys are stored in an ASIC (Application Specific Integrated Circuit) on the print head to reduce the opportunity for fraud. The microcontroller on the print head controls the printing operation including loading of NVM (Non Volatile Memory), decoding of messages with assistance of a DES (Data Encryption Standard) engine on the print head ASIC, and initiating of printing. The microcontroller helps to reduce the complexity of the ASIC.

The print head ASIC decodes the mail position for

printer sequencing, provides the proper timing for driving the print nozzles, supports external ink supply monitoring, interfaces to the NVM; support external communications, and performs self-test functions. The print head NVM also stores inscription representations. The meter vault stores a table of enabled inscriptions. When the operator at the mailing machine wishes to select an inscription, the print head transfers a list of the available options to the meter vault. The vault screens for only the enabled inscription s and sends the information to the mailing machine. The operator's response is forwarded from the meter vault to the print head.

As part of the system start-up process, the print head issues a message to the meter vault which directs the meter vault microcontroller to receive updated program data, only if, that updated program data version has not already been written to the non-volatile memory of the meter vault. The print head then encrypts the updated program data and transmits that encrypted data to the meter vault. The microcontroller of the meter vault then decrypts the updated program data and stores the data in the nonvolatile memory of the meter vault. The program update code is loaded into the print module after fabrication by the manufacture and prior to shipment.

In the accompanying drawings:

Fig. 1 is a schematic of a postage metering system in accordance with one embodiment of the present invention;

Fig. 2 is a schematic illustration of a communication path between the meter vault, mailing machine and print head units and of the respective control systems in accordance with an embodiment of the present invention;

Fig. 3 is a process diagram of the start-up process of the postage meter system in accordance with an embodiment of the present invention;

Fig. 4 is a process diagram of the slogan selection process of the postage meter system in accordance with an embodiment of the present invention; and

Fig. 5 is a process diagram for mail processing of the postage meter system in accordance with an embodiment of the present invention.

Referring to Fig. 1, a postage meter system, generally indicated as 11, includes a mailing machine base 12. The mailing machine base 12 is of any suitable conventional design and, in the preferred embodiment, includes a feeder section 13, singulator 14 and scale section 15 positioned serially along a mail flow path. Following the scale section 15 is a print station at location A which is followed by a stacker 17. Any suitably designed feeder section 13, singulator section 14, scale section 15 and stacker section 17 may be used. The operation of the respective sections 13, 14, 15, and 17 is under the control of a mailing machine controller 21. Power to the system is provided by a conventional power supply 19. It should be appreciated that the mailing machine controller 21, in the preferred embodiment, will control such additional functional systems as the operator keyboard and display, unsecured departmental accounting (not shown) and other conventional system functions. As depicted in Fig. 1, a programmable read only rates memory (PROM 22) is detachably mounted to the mailing machine controller 21 to provide rate information to the mailing machine controller in any suitable conventional manner.

Also, housed in the mailing machine is a printer interface 23, slogan box 25, meter vault 24 and print head/controller 27, hereafter referred to as print head 27.

The print head 27 is mounted to rails 30 and 31 by any suitable means to be positionable, by any convention means such as by a motor (not shown) between a first position "A" which is the print position, a second position "B" which is a tape print position, and a third position "C" which is a cleaning position. At position "C" the print head 27 is brought into contact with a nozzle cleaning system of any suitable design such that, for example, where ink jet print technology is utilized by the print head 27, the nozzles may by cleaned. The positioning of the print head 27 along the rails 30 and 31 is under the control of the mailing machine controller utilizing any suitable conventional control means.

Also, the mailing machine 12 includes provision for allowing the external connection of an external interface unit (EIU 26) to the printer interface 23 by any conventional means. The EIU 26 provides additional microprocessing functionality to the system 11 utilizing any suitable method.

Referring to Fig. 2, the meter vault 24 includes source accounting memory 40 and 41, program memory 42, ASIC 43, CPU controller 44, and keyboard/display 45. As more specifically described subsequently, the ASIC 43 provides two RS-232 communications ports 46 in any suitable conventional means for facilitating communications with the mailing machine 21.

The communication port 46 is modified to include an extra pin for receiving DC power from the mailing machine.

It should be appreciated that the keyboard and display 45 provides an operator or postal agent a means of recharging the accounting registers of the accounting memory 40 and 41 through the keyboard in any suitable conventional manner.

The mailing machine controller 21 is comprised of a controller CPU 50, code ROM 51, code RAM 52, user input/output 53, motor controller 54, and sensor controller 55. Also provided is a scale interface 56 and UART interface 57. The UART interface 57 is of any conventional design for allowing asynchronous serial communication. Of principle concern to the preferred embodiment of the present invention is that the UART interface facilitates communication between the mailing machine controller 21 and the other system units 23, 24, 25, 26 and 27.

The print head 27 is comprised of a CPU controller

60, nonvolatile memory units 61 and 62, ASIC 63 and print units 64, 65, 66. In the preferred embodiment it is contemplated to use multiple ink jet printing units.

Meter vault 24 communications to the print head 27 are routed through the printer interface 23 along communication path P47. The meter vault 24 securely communicates with the print head 27 using DES encryption. A number of encryption keys are preloaded into the ASIC 63 of the print head 27 and ASIC 43 of the meter vault 24. This will make discovering the keys impossible without reverse engineering of the ASIC 43 or 63. Communications path 47 is also used to select inscriptions and slogans in conjunction with the slogan box 25. A printer interface path P46 provided for electrical communication with the EIU 26. As aforenoted, the EIU 26 represents an external unit which can be attached to the meter vault 24 to provide enhanced capability to the meter vault 24 when the meter vault 13 is used in combination with the featured mailing machine.

The printer interface 23 serves as a junction board for the mailing machine 21, meter vault 24, print head 27 and a slogan box 25. By providing specific communication paths P13, P14, P17, P37, P46, P47 and P57 within the printer interface 23, the individual subsystems can be isolated in such a manner to remove the necessity for interdependent security measures.

The slogan box 25 stores graphics images representing the fixed part of the standard indicia (e.g., the eagle printed on US mail), low-value indicia, permit mail indicia, town circle (where appropriate), inscriptions, and slogans. It also stores the fonts for printing the variable data on the mail piece. All of the graphics data is either encrypted or signed in the slogan box 25 non-volatile memory (not shown). Only the print head 27 contains the necessary decryption key to properly interpret the data. Because of the different indicia formats, each country will have its own indicia graphics, therefore its own slogan box 25 product code number.

When a new print head 27 is positioned in the mailing machine 17, the controller 21 checks the local NVM 61 and 62; if it is un-initialized, the controller reads the slogan box 25 to retrieve the necessary graphics information. The print head 27 decrypts or verifies this data and programs it into its NVM 61 and 62. In the event that the print head NVM 61 and 62 are smaller than the slogan box NVM, only the subset of graphics necessary for a particular mail run is loaded into the print head NVM 61 and 62. If the NVM 61 and 62 should become corrupted, e.g., fail a checksum test, the controller 60 can request a new memory download as though it were newly installed.

When the mailing machine microcontroller 21 initiates the meter ad selection option as a result of operator selection via the user 1/0 53, the slogan box 25 will transfer a text description of each of its slogans to the mailing machine microcontroller 21 through the print head 27 and meter vault 24. Once the operator responds with the selected slogan to print by selection of the appropriate operator key on the mailing machine 11, the slogan box 25 transfers the bit-map slogan image to the print head 27 if it is not already loaded in the print head NVM 61 and 62.

The slogan box 25 electrically connects to the print head 27.

The print head 27 prints the indicia including postage amount, digital tokens, piece count, and date as well as an optional inscription and slogan on each mail piece. The fixed part of the image, fonts for the variable parts of the image, and inscription bit-maps are programmed into the print head's NVM 61 and 62 when the print head is first installed in the mailing machine 17. The meter vault 24 will send a message to the print head 27 indicating the format of the town circle. The print head 27 obtains the town circle information as either a text string from the meter vault 24 or a bit map from the slogan box and programs its NVM with the data. For each mail piece, the meter vault 24 transfers the variable indicia information such as the postage amount, digital tokens, meter serial number, and piece count to the print head 27. The print head controller 60 programs registers (not shown) in the ASIC 63 with this information. When the mailing machine microcontroller 21 commands the print head 27 to print, the ASIC 63 combines the fixed and variable parts of the image for printing by the print units 64, 65 and 66 utilizing any suitable technique.

The interface with the meter vault 24 includes encrypted information; only the meter vault 24 and the print head 27 know the proper keys to utilize the information. The keys are stored in an ASIC 63 on the print head 27 and the meter vault ASIC 43.

The controller 60 on the print head 27 controls the printing operation including loading of NVM 61 and 62, decoding of messages and initiating of printing.

The print head ASIC 63 also decodes the mail position for printer sequencing, provides the proper timing for driving the print nozzles, supports external ink supply monitoring, interfaces to the NVM 61 and 62; supports external communications, and performs self-test functions.

The print head NVM 61 and 62 also stores inscription representations. The meter vault 24 stores a table of enabled inscriptions when the operator at the mailing machine 11 wishes to select an inscription, the print head 27 transfers a list of the available options to the meter vault 24. The vault 24 screens for only the enabled inscriptions and sends the information to the mailing machine microcontroller 21. The operator response is forwarded from the meter vault 24 to the print head 27.

Referring also to Figs. 3, 4 and 5, it is observed that the meter vault 24 may have any suitable known independent housing and internal security measures as well as the print head 27 may like-wise have independent housing and any suitable internal security since critical communication between the mailing machine controller 21, meter vault 24 and print head 27 are secure communications.

Particularly, referring to Figs. 3, 4 and 5, during the system start-up process, the print head 27 generates a random number which is then encrypted by the ASIC 63. The random number is transmitted via path P47 in the encrypted and clear form to the meter vault 24. The meter vault 24 decrypts the random number and compares with the clear text. If a match is determined, then the meter vault 24 generates a message of critical data including the random number. The meter vault message is encrypted and transmitted along path P47 to the print head 27. The message is then decrypted and, if the random number transmitted matches the generated random number, the encrypted information is stored in NVM 61 and 62 for use in subsequent printing. The print head 27 then transmits a request to the meter vault 24 along path P47 to send the program software version number. In response, the meter vault 24 sends the software version number along path P47 which is received by the print head 27 and compared to a software version number stored in the nonvolatile memory 61 or 62 of the print head 27. If the version number transmitted to the print head 27 is equal to or greater than the version number stored in the non-volatile memory 61 or 62 of the print head 27 then the system is ready for normal operation. If the version number transmitted to the print head 27 is less than the version number stored in the non-volatile memory 61 or 62 then the print head 27 transmits the updated program data to the meter vault 24 which stores the updated program data in its non-volatile memory 40 or 41. The system is now ready for normal operation.

Particularly referring to Fig. 4, in the manner described above, an operator may submit a query to the slogan box 25 for available slogans via paths P14 and P47.

The slogan box 25 transmits the slogan descriptor information via path 47 to the meter vault 24 which masks the unusable postal inscriptions. The meter vault 24 than relays the modified message to the mailing machine controller 21 for presentation to the requester. The requester then makes a selection which the mailing machine controller 21 transmits via path P17, P57 to the slogan box 25. The slogan box 25 then transmits the data for the graphic image via path P57 to the print head 27 which stores the graphic information in the memories 61 and 62.

The print head 27 then transmits via path P17 the information received to the mailing machine controller 21.

Referring now to Fig. 5, to process mail items, a postage value is either operator selected or determined based upon data from the scale 15 via the scale interface 56. The mailing machine controller 21 transmits the appropriate postage value to the meter vault 24 via path P14 which then accounts for the postage value. The meter vault 24 then encrypts the critical accounting data and transmit the encrypted data via path P47 to the print head 27 where the data is decrypted. Once the data is successfully decrypted, the print head 27 transmits an OK to print message to the mailing machine controller 21 via path PI 7. Upon receipt of the OK message from the print head 27, mailing machine controller 21 then transmits along path P17 a print enable and printing is commenced.

It should now be appreciated that the afore described system provides the benefit of unlacing system security and provides a method of generating secure communications between system units.

Claims

1. A postage meter mailing system, having:

   a meter vault (24) including a microcontroller (44), said microcontroller of said meter vault (24) having a communication means (43) for receiving and transmitting data messages and a memory (40, 41) for storing program data;

   a printer (27) including a microcontroller (60), said microcontroller of said printer having a communication means (63) for receiving and transmitting data messages and a memory (61, 62) for storing program data;

   interface means (23) for providing a communication path between said meter vault (24) and said printer (27);

   said memory (40, 41) of said meter vault (24) having program version identification means stored therein for identifying a program data version;

   said memory (61, 62) of said printer (27) having stored therein program update data and meter vault program identification means for identifying associated program data versions; said print head microcontroller (60) having means for requesting said meter vault microcontroller (44) to transmit said program data version and for determining whether said program data version is associated with said meter vault program identification means and for transmitting said update data to said meter vault (24) only if said determination is valid.

2. A postage meter mailing system, having

   a meter vault (24) including a microcontroller (44), said microcontroller of said meter vault having a communication means (43) for receiving and transmitting data messages and a memory (40, 41) for storing program data,

   a printer (27) including a microcontroller (60), said microcontroller of said printer having a communication means (63) for receiving and transmitting data messages and a memory (61,

62) for storing program data;

interface means (23) for providing a communication path between said meter vault and said printer, said memory (40, 41) of said meter vault (24) having stored therein data representing a numeric version of said program data;

said memory (61, 62) of said printer (27) having stored therein program update data and a data representing an associated numeric version for identifying associated program data;

said print head microcontroller (60) having means for requesting said meter vault microcontroller (44) to transmit said data representing said numeric version of said program data and comparing said data representing said numeric version with said data representing said associated numeric versions wherein, only if said numeric version is less than said associated numeric version, said print head microcontroller (60) transmits said update data to said meter vault (24).

3. A method of updating program software of a postage meter system having a meter vault (24) including a microcontroller (44), said microcontroller of said meter vault having a communication means (44) for receiving and transmitting data messages and a memory (40, 41) for storing program data,

a printer (27) including a microcontroller (60), said microcontroller of said printer having a communication means for receiving and transmitting data messages and a memory (61, 62) for storing program data; and

interface means (23) for providing a communication path between said meter vault and said printer,

the method comprising:

storing numeric data in said memory (40, 41) of said meter vault (24) representative of said program data version,

storing program update data in said memory (61, 62) of said printer (27),

storing associated numeric data in said memory (61, 62) of said printer (27) representative said program data version associated with said program update data,

comparing said associated numeric data in said printer memory (61, 62) to said numeric data in said meter vault memory (40, 41), and

transmitting said update data to said meter vault, only if, said associated numeric data is greater than said numeric data.

4. A method of updating a program software as claimed in Claim 3 further comprising the step of setting a transfer bit in said printer memory (61, 62) the first time said comparison is made.

5. A method of updating a program software as claimed in Claim 4 further comprising the step of first checking said transfer bit and if set aborting said method.

6. A postage metering system of the type having a meter vault (24) including a memory for storing a meter vault software program having a version number, wherein the improvement comprises:

means for determining the version number of the meter vault software program;

means for comparing the detected version number with a desired version number; and

means for transmitting a new meter vault software program to the meter vault if the meter vault version number is earlier in sequence than a desired version number.

7. The postage meter system of claim 6, wherein the determining means is operable to determine the version number of the meter vault software program during a start-up routine for the postage meter system.

8. The postage meter system of claim 7, further comprising:

a printer, and

interface means for providing communication between the meter vault and the printer; and

wherein the new meter vault software program is located in a memory of the printer.

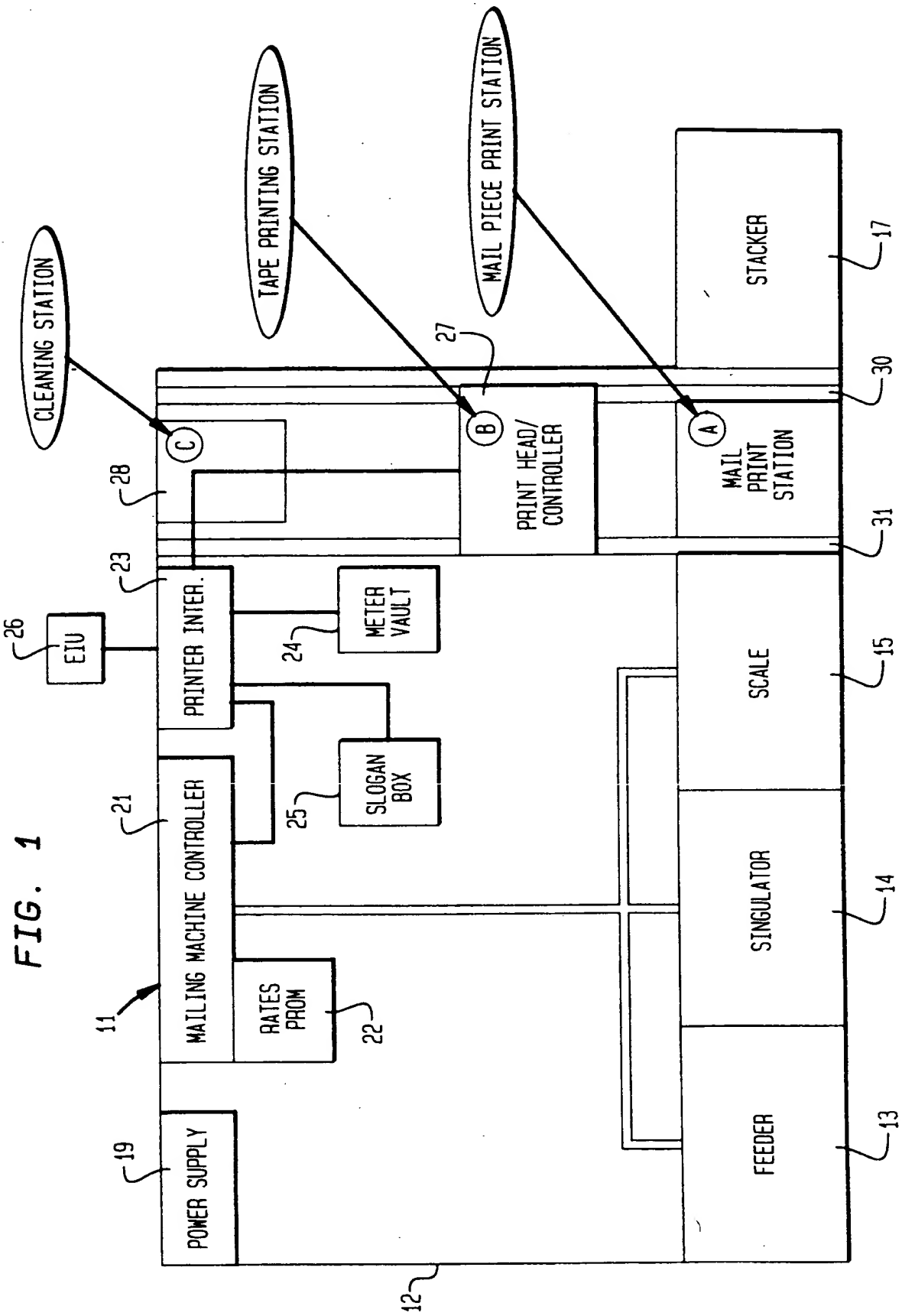

CLEANING STATION
TAPE PRINTING STATION
MAIL PIECE PRINT STATION
STACKER
17
27
30
C
B
A
PRINT HEAD/ CONTROLLER
MAIL PRINT STATION
28
31
23
PRINTER INTER.
METER VAULT
24
26
EIU
SCALE
15
SLOGAN BOX
25
21
MAILING MACHINE CONTROLLER
SINGULATOR
14
RATES PROM
22
11
POWER SUPPLY
19
FEEDER
13
12

FIG. 1

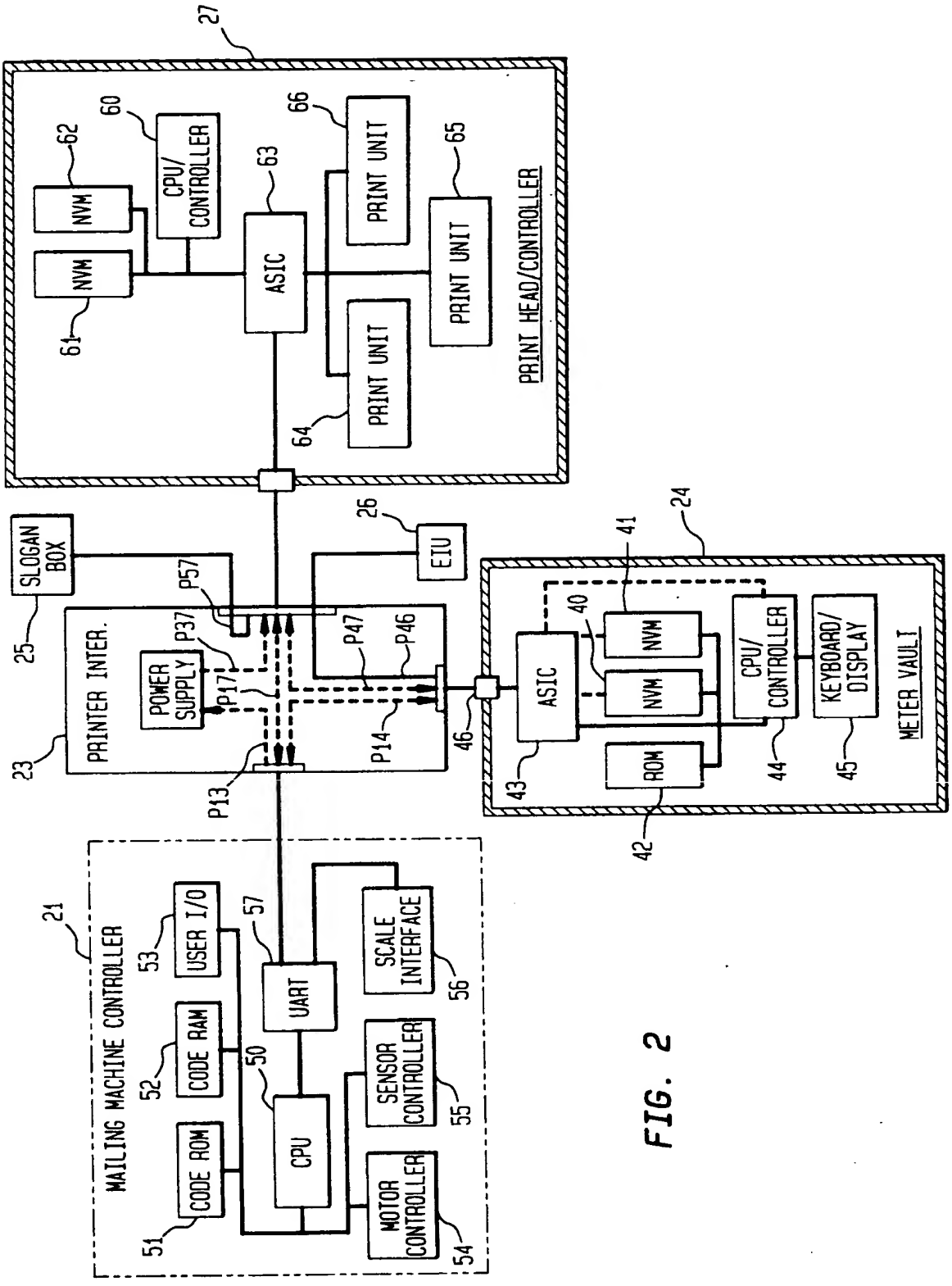

27
PRINT HEAD/CONTROLLER
60
CPU/ CONTROLLER
62
NVM
61
NVM
63
ASIC
66
PRINT UNIT
65
PRINT UNIT
64
PRINT UNIT
26
EIU
SLOGAN BOX
25
P57
P37
P17
P47
P46
P14
P13
23
PRINTER INTER.
POWER SUPPLY
46
24
41
40
NVM
NVM
ASIC
CPU/ CONTROLLER
KEYBOARD/ DISPLAY
METER VAULI
ROM
43
44
45
42
21
MAILING MACHINE CONTROLLER
53
USER I/O
57
UART
SCALE INTERFACE
56
52
CODE RAM
50
CPU
SENSOR CONTROLLER
55
51
CODE ROM
MOTOR CONTROLLER
54

FIG. 2

FIG. 3

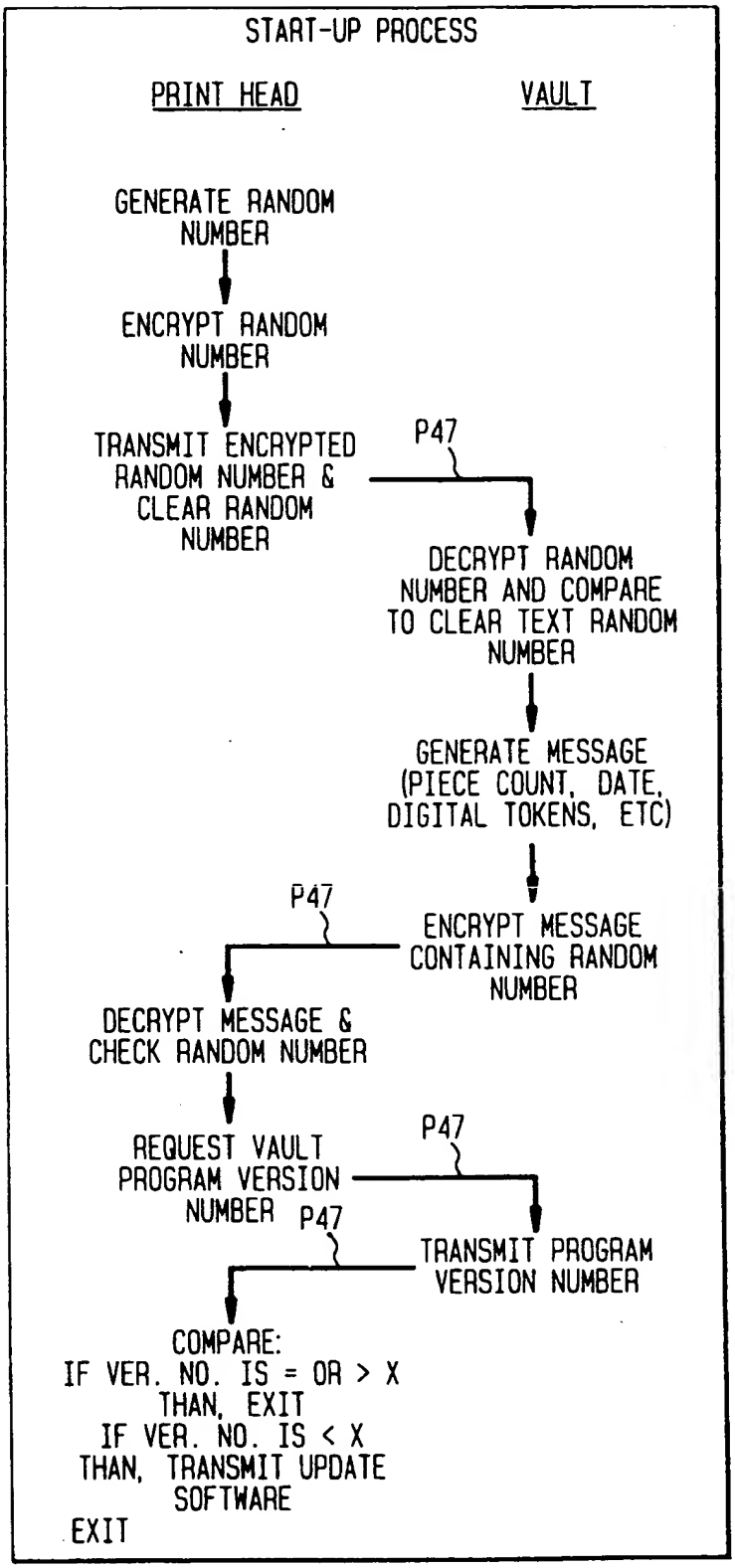

START-UP PROCESS
PRINT HEAD
VAULT
GENERATE RANDOM NUMBER
ENCRYPT RANDOM NUMBER
TRANSMIT ENCRYPTED RANDOM NUMBER & CLEAR RANDOM NUMBER
P47
DECRYPT RANDOM NUMBER AND COMPARE TO CLEAR TEXT RANDOM NUMBER
GENERATE MESSAGE (PIECE COUNT, DATE, DIGITAL TOKENS, ETC)
P47
ENCRYPT MESSAGE CONTAINING RANDOM NUMBER
DECRYPT MESSAGE & CHECK RANDOM NUMBER
REQUEST VAULT PROGRAM VERSION NUMBER
P47
P47
TRANSMIT PROGRAM VERSION NUMBER
COMPARE:
IF VER. NO. IS = OR > X
THAN, EXIT
IF VER. NO. IS < X
THAN, TRANSMIT UPDATE SOFTWARE
EXIT

FIG. 4

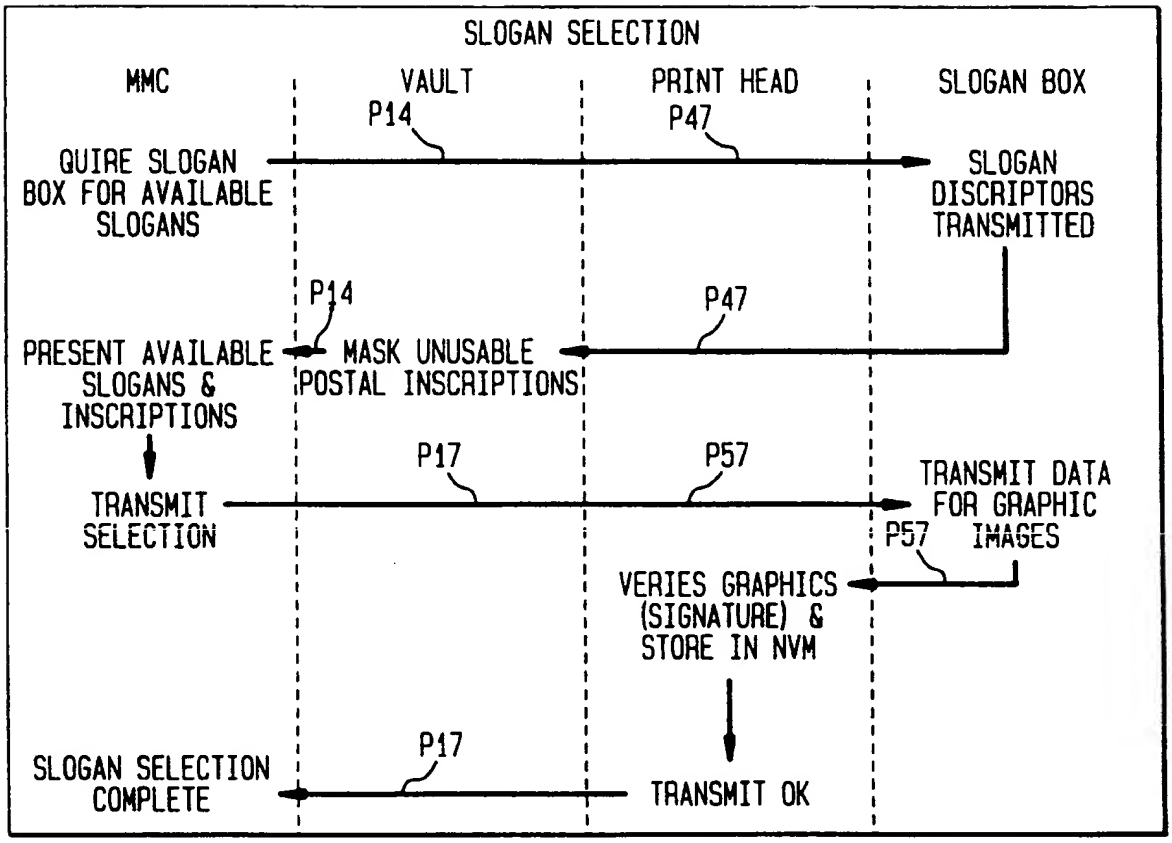
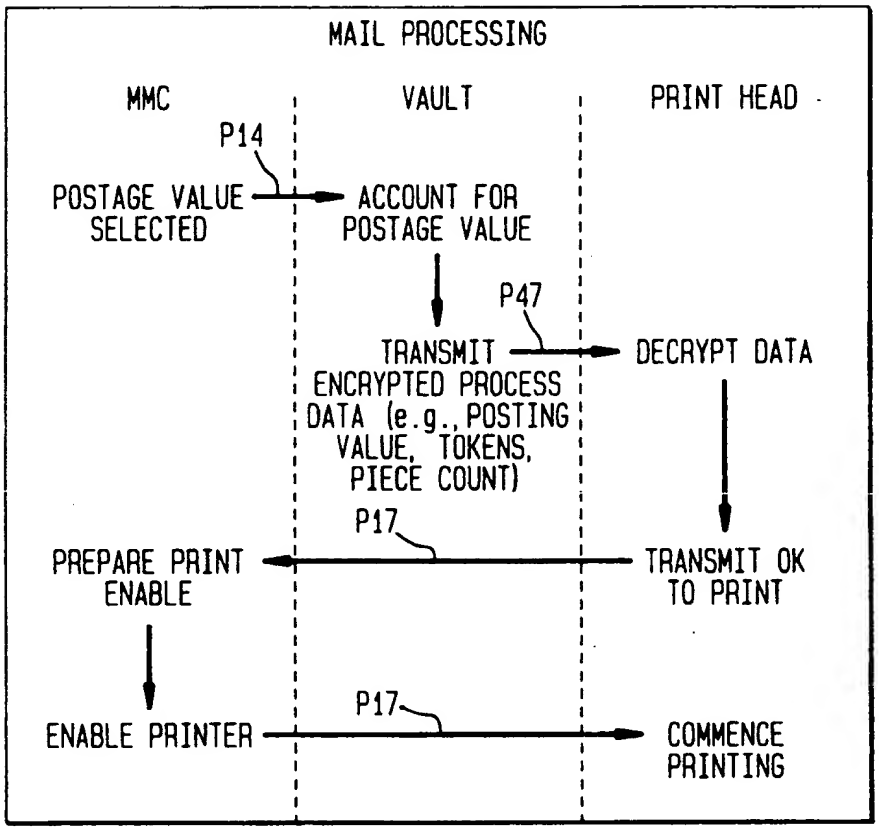

SLOGAN SELECTION
MMC
VAULT
PRINT HEAD
SLOGAN BOX
P14
P47
QUIRE SLOGAN BOX FOR AVAILABLE SLOGANS
SLOGAN DISCRIPTORS TRANSMITTED
P14
P47
PRESENT AVAILABLE SLOGANS & INSCRIPTIONS
MASK UNUSABLE POSTAL INSCRIPTIONS
P17
P57
TRANSMIT SELECTION
TRANSMIT DATA FOR GRAPHIC IMAGES
P57
VERIES GRAPHICS (SIGNATURE) & STORE IN NVM
P17
SLOGAN SELECTION COMPLETE
TRANSMIT OK

FIG. 5


MAIL PROCESSING
MMC
VAULT
PRINT HEAD
P14
POSTAGE VALUE SELECTED
ACCOUNT FOR POSTAGE VALUE
P47
TRANSMIT ENCRYPTED PROCESS DATA (e.g., POSTING VALUE, TOKENS, PIECE COUNT)
DECRYPT DATA
P17
PREPARE PRINT ENABLE
TRANSMIT OK TO PRINT
ENABLE PRINTER
P17
COMMENCE PRINTING